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ABSTRACT

Constructive planning for technical education in developing countries must begin with a definition of technical education and its objectives. Technical education, as opposed to skill-oriented vocational training, is built upon a solid theoretical basis which supports one or more skill components. As such, it provides the student with the potential for growth within a given technical discipline or into a related technology. The objectives of technical education are to produce a technician who can not only perform the skill components of the field and understand why they must be performed in the prescribed manner, but also relate social values to the technical field. To obtain these objectives, the student needs a modicum of maturity and a realization of his/her intellectual potential: therefore, the most appropriate time for technical education occurs at the tertiary level in an environment reproducing the setting in which the technical skills are likely to be practiced. Whether the learning takes place in a university or not, instructional patterns should involve theory, practice, and related arts and sciences. Minimum competency standards must be enforced and instructors must be aware of the differing motivational problems of non-traditional students. Finally, technical education should occur within the society it is to serve, so that students can learn within the context of their society's relation with technology. (AYC)

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THE DIMENSIONS OF TECHNICAL EDUCATION

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THE DIMENSIONS OF TECHNICAL EDUCATION

Ursula Schwerin

Any society, in considering its educational structure must attempt to deal with all segments of its population within the context of societal values and needs. Thus, a concise definition of technical education becomes essential to any planning process that wishes to do justice to the society as a whole, to the needs of industry and the professions, and specifically, above all, to the complex problems presented by the incongruities of student interest, potential, achievement levels, and goal satisfaction.

Constructive planning for technical education can occur only if the professions and industry understand and recognize the need for technical support services as an integral part of the larger disciplines in which they exist. There must be willingness to acknowledge the absolute necessity of technical expertise at various levels of complexity, and there must be further understanding that professional and technical sophistication demand careful dovetailing of individual competencies into comprehensive wholes.

International literature on the subject appears to be in some agreement that the post-second world war technological explosion created a worldwide need to supply theoretical scientists with an adequate support structure of technicians at all competency levels. There appears to be further agreement that the earlier elitist view of university education should be rejected in favor of an understanding that functional education at the tertiary level requires the coexistence and interdependence of the sciences, arts, and technical systems along with the awareness that only such a comprehensive whole can serve a complex technological society.

There is, however, little agreement in the literature on some of the following questions:

1. What exactly is technical education and how does it differ from vocational training?
2. What are the desired outcomes of technical education?
3. At what level in an educational sequence and in what type of an institution should technical education take place?
4. Which factors constitute educational and personal readiness for the student to profit maximally from technical education?
5. Must technical education occur within the specific society it is to serve?

It is to these questions that the body of this presentation will address itself.

1. What is Technical Education and how does it differ from Vocational Training?

In much of the literature on the subject, the terms "technical" and "vocational" are used interchangeably, just as there seems to be no conscious differentiation of the concepts "education" and "training". In my view, it is absolutely essential that each term be clearly delineated if a sound rationale is to underlie the educational design in a given society. In its purest form, the term "training" reflects that which is specific, narrow, geared to the performance of a skill; while the term "education" signifies a nonspecific, broader approach, geared to the acquisition and utilization of knowledge in a more global sense. A training sequence is characterized by its concreteness; the educational sequence, while incorporating many concrete elements, is characterized by its emphasis to assist students to deal with the abstract.

It is interesting to note that the term "vocational" is generally matched with the term "training", while "technical" is more often combined with "education". To this writer, any other combination of terms would really constitute a functional anachronysm. The definitions of the terms vocational training and technical education are essentially operational ones. Vocational training is that which generally occurs at a relatively elementary level, is specific and applied, relates to simple, concrete skills which can be taught and learned without the benefit of a theoretical base. It really refers to the "how" of a skill. Technical education, on the other hand, is generally more advanced in that its foundation is built on a solid theoretical basis which supports one or more skill components. This broader educational concept reflects the requirement that the technician understand the "why" of a skill, can comprehend it within the constellation of its arts and science base and can relate it to societal values and needs. As such, it provides the student with the potential for growth, either upward within a given technical discipline or lateral, into a related technology.

Since this paper deals with the concept of "technical education", I must once more stress the importance of providing continued growth for the student. It should be remembered that education is ongoing throughout life, that growth is an essential component of that process--that without the potential for growth, a dead end can be created, a sophisticated one, perhaps, but nevertheless, a dead end.

2. What are the desired outcomes of technical education?

It may seem strange that a discussion of "outcome" must precede the many other points to be considered for the effective education of a technician. It is essential, however, to define carefully exactly what the objectives of technician education are if planning is to be both rational and functional.

In a global sense, it is desirable to produce a technician who understands the larger discipline in which his/her skill specialty exists, can relate to other skill specialty areas in the field in a pattern of mutual interdependence. There must be demonstrated competency in the performance of the skill components (how), along with the understanding that a particular skill must be performed in a prescribed functional manner (why). None of this will be sufficient, however, if the technician cannot relate to societal values which have an impact on the general field in which he/she functions. It would appear then that, in its broadest sense, the product of technical education should be an individual who can competently perform a given skill or skills, understands the theoretical underpinning for the skill, as well as the scientific basis for its particular design. The individual must understand that his/her skill(s) cannot exist in isolation but can become functional only in a dovetailed pattern of mutual interdependence. In addition, I support the viewpoint, which is not shared by the majority of educational planners, that the technician who functions in a complex system will be truly functional only if his/her communication skills reflect clarity and precision as well as sensitivity to the impact that his/her job performance has on the physical, social, and psychological environment of the consumer group.

3. <u>At what level in an educational sequence and in what type of an institution should technical education take place</u>?

In considering both questions, it is once again necessary to emphasize that I am addressing <u>technical education</u> as previously defined within the context of the <u>objectives</u> outlined in the foregoing statement. Central to the questions of level and type of institution should be the goal of an educationally well rounded individual, capable of logical thinking and problem-solving, one who is capable of independent judgment while recognizing the limitations of technical expertise as defined earlier. I am, therefore, seeking a time in the educational sequence when the student has achieved a modicum of maturity, can assess and balance self-interest with societal values and needs, and has some realistic view of his/her own intellectual potential.

In my view, the most appropriate time for technical education occurs at the tertiary level. During my years of experience, I have observed many career-oriented programs at the secondary level. Whether by design or not, their focus was invariably a vocational one, specific in nature, stressing the acquisition of a particular skill. I regard this as an entirely appropriate emphasis for the student in the early- and middle-teen years when secondary education occurs in most societies. Curiosity levels are high, and vocational interests are easily fostered, through hands-on experiences. Discussion of theory underlying a skill generally evokes little enthusiasm.

The tertiary level is the one when most students demonstrate readiness for the comprehensive approach required in technical

education. It is difficult for me to speak of a non-university setting only since it is my view that any technical specialty is best taught and learned in an atmosphere and environment reproducing the setting in which it is likely to be practiced. It matters not whether the learning takes place in a university or non-university setting; what does matter is that functional instructional patterns involving theory, practice, and related arts and sciences are established. Implicit in that statement is the suggestion that industrial, business, and professional bases be heavily involved in the skill components of technical education. This is desirable since the latest techniques, systems, and equipment must be available and continually updated. The student, therefore, learns in a framework of reality. This is, however, only the last building block in a functional technical education system. It must be preceded by a theoretical framework and, if there still be gaps in knowledge, the appropriate arts and science foundations. In my view, if the larger discipline in which the technical specialty occurs is university-based, let the theoretical foundations for the technical student take place in the same setting. Frequently, simulated situations, such as clinics and laboratories, have to be especially designed for technical institutes or colleges, where technical education occurs in relative isolation without the benefit of the larger discipline. Students must, after all, have the opportunity to function within a realistic frame of reference. Therefore, to the extent that the possibility presents itself for the inclusion of technical programs into the setting of larger disciplines, it would be desirable.

Thus, if a society decides to structure its technical education into a formal system of Higher Technical Institutes, it will find it necessary to teach much of its practical material through laboratory and clinical simulations. Such a system would do well to incorporate scheduled structure practical experiences which allow the students (1) to function in industry, business, and the professions as part of their education, and (2) to interact with students in other technical specialties or wider professional studies regardless of the institution in which these might be formally based.

Of almost greater importance than the educational setting is the quality of instruction. Up-to-date competency in the technical field must be complemented by the ability to teach and transmit theory and practice in the context in which they are currently practiced. Thus, it would appear essential that ongoing professional development on the part of the teachers requires a balance of practical experience and educational theory.

4. Which factors constitute educational and personal readiness for the student to profit maximally from technical education?

The question of student readiness has been addressed, to some extent, in each of the foregoing segments. Primarily, however, I have dealt with the traditional student whose age and development reflect that of the general primary and secondary school population.

Yet, our world must prepare, at this point in time, to deal with a far larger, more diverse student constituency.

Regardless of the stage of development at which a particular country or society finds itself, increased population mobility--as well as increased business, industry, and professional complexities--demands that educational planners rethink and modify their approaches, particularly those geared to the higher levels of education. Mass media and instant communication have produced a world population which sees itself as truly motile. Depending on the cultural pattern in which it occurs, this capability for movement expresses itself in a variety of ways:

a. Both males and females seek careers which have heretofore been reserved to one or the other sex.

b. Individuals in well established careers experience personal and professional frustrations and seek new career directions.

c. Age is no longer seen as a barrier to seeking formal education.

d. Traditional societal roles are being questioned by both sexes.

e. Earlier educational achievements are questioned as to their usefulness.

Before enumerating these items, I used the term "motility", because it signifies capability of motion, rather than movement itself. I believe that the use of this term is appropriate because of the as yet uncontrolled nature and tentativeness of what is occurring in most societies where attempts are made to deal with these new cultural pressures.

It is my view that developing countries find themselves in strong positions to deal positively with these new, intrusive needs. They can be utilized to serve the society well. Whereas educational planners in well established systems must seriously rethink traditional patterns of delivery, developing countries have the unique opportunity to plan realistically without first having to unlearn their past.

Am I implying that this new, more diverse student constituency is educationally and personally prepared to profit maximally from technical education? I think not.

Educational readiness will differ widely; the setting of realistic minimal competency levels for admission into technical programs at the tertiary level is essential. Let me emphasize here, once again, that setting of such prerequisites must be preceded by clearly defined objectives for (1) the outcomes of the entire educational sequence, (2) the theoretical framework to be studied within the sequence, and (3) the specific skill components to be studied within the sequence.

Personal Readiness is, in my view, far more difficult to determine, since it is closely related to the emotional well-being of the individual. In many cultures, technical education at the tertiary level is seen by the total society as something less than university education. While such value judgments are, of course, ill-conceived, they are also a fact of life and must be dealth with realistically.

Individuals in the technical specialties need the assurance that their particular skills constitute a meaningful contribution to the larger field. The notion that technical education is relegated to those with lower intellectual potential is fallacious, of course. It in no way recognizes individual emotional and interest levels, not does it address questions of talent or special skill development. The inferiority feelings of which I speak are fostered by ignorance, but they have been demonstrated by faculty and students in technical higher education alike. They are not only nonproductive but dangerous. If allowed to persist, they easily become self-fulfilling prophecies.

An additional problem worth mentioning here centers around the adult who wishes to return to school. Regardless of earlier achieved educational levels, the individual is likely to have experienced some years in a position of power or control, most often through parenthood. The sudden assumption of student status requires considerable emotional maturity, which is frequently difficult to achieve.

Any educational system that wishes to serve the widest possible student constituency must be sensitive to factor described here.

5. Must technical education occur within the specific society it is to serve?

My earlier comments on mass media, instant communication, and social mobility are pertinent here, also. One might assume that the near obliteration of geographical boundaries would obviate discussion on the above subject. The social and cultural barriers between societies remain real, however, and it is these differences which merit consideration here.

The planning phases for technical education as a whole or for a given specialty must deal with all the human factors discussed earlier as well as with one additional one relating to the technology itself. I am really referring to the interaction of the society's cultural patterns with technical equipment, systems, and instrumentation.

It is because of the need for this sensitive interaction that, in my view, very early efforts to establish the technical education system within the country in which it is to function is absolutely essential. Undoubtedly, the first group of individuals to be so educated will have experience in a developed country where the technology is sufficiently advanced to deal with all aspects of

of the larger discipline or field in which the technology functions. Two factors become important here: (1) that individuals selected to be the first educated in the field have the intellectual potential and interest to go beyond that which the technical specialty requires, and (2) that these same individuals will be capable of reintegrating themselves into the cultural patterns from which they stem while assuming leadership in introducing and advancing the new technology within the framework of required cultural changes. Culture lag is a phenomenon most difficult to overcome. It requires sensitivity and a real belief that valuable group patterns can be preserved even in periods of drastic technologic change. Industries, business, and professions which locate in developing countries have shown themselves largely incapable of dealing with this issue. Their investment in expensive, complex equipment and systems has permitted no room for the consideration of the human factor, but has tended to impose values inconsistent with existent ones.

The introduction of technicians and professionals from developed countries has been of limited use only, largely because their professional expertise alone could not overcome the conflicting or lagging value systems. In my view, the very early identification of competent numbers of the indigenous population is essential, followed by their education in the country whose technology best suits the developing country's goals and aspirations. The most critical step is the one in which the new technically competent individuals return to their country, prepared not only to support developing professions and industries, through continuous updating of their own skills, but fully prepared to assume the responsibility for developing appropriate technical education sequences in their own country, into a comprehensive system which addresses technological needs within changing culture patterns.

Summary

Instead of summarizing my remarks in a conventional manner, let me introduce you to Robert N., radiologic technician, native of a developing country, educated in his specialty in the U.S., and now practicing his specialty in his own country. I met him during a recent visit to a Health Sciences Center in one of the Western States. On describing his activities and evaluating his experiences, he emphasized the following points.

He regards his technical education as absolutely first-class, but has had to adjust to considerably less sophisticated equipment upon his return to his home base at an urban hospital. He anticipates the need for returning periodically to the States as newer, more complex equipment is introduced. He indicates this as essential to his professional growth, since the sale of equipment includes only the most cursory instruction for use, not nearly adequate when using potentially dangerous energy with human beings. Robert describes his early experiences with patients in his country as "shattering" because of their fear of equipment and procedures, their unwillingness to

accept his assurances of the value of the procedure for diagnostic purposes. He wishes he had had the opportunity earlier to think about valid approaches and adequate preparation for his patients, both psychologically and culturally. At the same time, he expresses his confidence about his work as a member of a team whose specialties dovetail well with one another, and without whom his own specialty would be pretty meaningless. He expresses the view that it was really best for him to receive his education within the larger setting of a medical school, but he is grateful that basic science instruction was reserved to radiologic technology students, nursing, and respiratory therapy students--on a much simpler plane than medical students would experience. Robert speaks of the need for his own professional growth and is considering the larger field of radiation biology. He has recently been asked to assume responsibility for the establishment of a radiologic technology program in his home state and is asking the following questions:

1. What is the minimum age at which a young man or woman is old enough to assume responsibility for patients?

2. Should I attempt to set up a totally separate facility which simulates reality for the initial instructional sequences, and then introduce students to the hospital setting on a regularly scheduled basis?

3. Which competencies in the arts and sciences should candidates for the program have?

4. How long should the program be in order to produce a competent technician with further growth potential?

5. Should students receive some preliminary skills training in secondary schools?

While Robert's questions are different from those I originally posed, they are, nevertheless, reflective of the broader spectrum of concerns which confront any society that wishes to develop a viable program for the education of middle-level technicians and wishes to find the best solutions for the vast human resources.

The attached suggested bibliography might provide further clarification of some of the areas discussed in this paper.

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